

2. a) $x(t) = 4 \cos(5\pi t) - \pi/4$

$T = \frac{2\pi}{5\pi} = \frac{2}{5} \Rightarrow$ periodic function, $-\frac{\pi}{4}$ - constant

b) $x(t) = 4u(t) + 2\sin(3t)$

Because of the unit function $u(t) \Rightarrow x(t)$ is not periodic

c) $x(t) = 3 \cos(4t) + \sin(\pi t)$

$T_1 = \frac{2\pi}{4} = \frac{\pi}{2}$; $T_2 = \frac{2\pi}{\pi} = 2 \Rightarrow T = 4T_1 = \pi \cdot T_2 = 2\pi$

$\cos(4(t+2\pi)) = \cos(4t+8\pi) = \cos(4t)\cos(8\pi) - \sin(4t)\sin(8\pi) =$
 $= \cos(4t) \cdot 1 - \sin(4t) \cdot 0 = \cos(4t)$

$\sin(\pi t) \begin{cases} \rightarrow \pi \text{ is period} \\ \rightarrow k\pi \text{ is period, } k \in \mathbb{Z} \\ \rightarrow 2\pi \text{ is period} \end{cases} \Rightarrow x(t) \text{ is periodic}$

e) $x(t) = 4 \cos(3\pi t + \pi/2) + 2 \cos(8\pi t + \pi/2)$

$T_1 = \frac{2\pi}{3\pi} = \frac{2}{3}$; $T_2 = \frac{2\pi}{8\pi} = \frac{2}{8} = \frac{1}{4} \Rightarrow T = 2$

$\cos(3\pi(t+2) + \frac{\pi}{2}) = \cos(3\pi t + 6\pi + \pi/2) = \cos(3\pi t + 13\pi/2) =$
 $= \cos(3\pi t)\cos(13\pi/2) - \sin(3\pi t)\sin(13\pi/2) = \cos(3\pi t \cdot 0) - \sin(3\pi t) \cdot 1 =$
 $= -\sin(3\pi t) = \cos(3\pi t + \pi/2)$

$\cos(8\pi(t+2) + \pi/2) = \cos(8\pi t + 16\pi + \pi/2) = \cos(8\pi t + 33\pi/2) =$
 $= \cos(8\pi t)\cos(33\pi/2) - \sin(8\pi t)\sin(33\pi/2) = \cos(8\pi t) \cdot 0 - \sin(8\pi t) \cdot 1 =$
 $= -\sin(8\pi t) = \cos(8\pi t + \pi/2) \Rightarrow x(t) \text{ is periodic}$

d) $x(t) = \cos(2\pi t) + 2\cos(4\pi t) + \sin(\pi t)$

$T_1 = \frac{2\pi}{2\pi} = 1$, $T_2 = \frac{2\pi}{4\pi} = \frac{1}{2} \Rightarrow T = 2\pi$

$\cos(2\pi t) \begin{cases} \rightarrow 2\pi \text{ is period} \\ \rightarrow 2k\pi \text{ is period, } k \in \mathbb{Z} \end{cases}$

$\Rightarrow x(t) \text{ is periodic}$

$\sin(\pi t) \rightarrow \text{periodic}$

$$f) x(t) = 4 \cos(3\pi t + \pi/2) + 4 \cos(10\pi t + \pi/2)$$

$$T_1 = \frac{2\pi}{3\pi} = \frac{2}{3} ; T_2 = \frac{2\pi}{10\pi} = \frac{1}{5} \Rightarrow T = 2$$

$$\begin{aligned} \cos(3\pi(t+2) + \pi/2) &= \cos(3\pi t + 6\pi + \pi/2) = \cos(3\pi t) \cos(13\pi/2) - \\ &- \sin(3\pi t) \sin(13\pi/2) = \cos(3\pi t) \cdot 0 - \sin(3\pi t) \cdot 1 = \sin(3\pi t) = \cos(3\pi t + \pi/2) \\ \cos(10\pi(t+2) + \pi/2) &= \cos(10\pi t + 40\pi/2) = \cos(10\pi t) \cos\left(\frac{41\pi}{2}\right) - \sin(10\pi t) \cdot \\ &\cdot \sin(41\pi/2) = \cos(10\pi t + \pi/2) \Rightarrow x(t) \text{ is periodic} \end{aligned}$$

$$g) x[n] = 4 \cos(\pi n - 2)$$

$$\Omega = \pi, N = \frac{2\pi}{\pi} = 2$$

$$\Omega = \frac{2\pi m}{N} \Rightarrow \pi = \frac{2\pi m}{N} \Rightarrow m = 1$$

$x(t)$ is periodic

$$h) x[n] = 2 \sin(3n)$$

$$3 = \frac{2\pi m}{N} \Rightarrow N = 2\pi ; m = 3$$

$$i) x[n] = 4 \cos(0.5\pi n + \pi/4)$$

$$\frac{\pi}{2} = \frac{2\pi m}{N} \Rightarrow N = 4, m = 1$$